Positive Train Control (PTC) Full Working Group
March 4-6, 2003 - Philadelphia, Pennsylvania

March 4: Full Working Group Meeting convened at 8 a.m.

Note 1: The minutes and all of the meeting presentations will be posted on the Volpe Website at: http://imsserver.volpe.dot.gov. There are no user ID's or passwords required.

Note 2: If you connect through the FRA Website, rather than going directly to the Volpe Website, your User Name and User ID will be the first letter of your first name and all of your last name.

Filenames and their association with the presenters are as follows:

	Presenter & Organization	**Filename (all Adobe PDF format)**
1	Dr. Ted Giras, University of Virginia Marc E. Monfalcone, UVA Dr. Lori M. Kaufman, UVA Dr. Donald E. Brown, UVA Dr. Ronald D. Williams, UVA	ASCAP 03-2003.pdf Introduction A Day in the Safety of a Train System ASCAP Safety Behavior Models Knowledge-Based Blackboards Choice Model Knowledge-Based Blackboards ASCAP Web-based Parallel Processing Cluster Computer
2	Alan Polivka, TTCI Craig Shier, Lockheed Martin Howard Moody, AAR	NAJPTC 03-2003.pdf
3	Dr. Tom Raslear, FRA	No PowerPoint presentation, incorporated into minutes
4	John Vogler, APTA	NJT ASES 03-2003.pdf
5	Larry Light, Amtrak Jim Hoelscher, Alstom	ATK ACSES 03-2003.pdf
6	Andy Schiestl, BNSF	BNSF 03-2003.pdf
7	Grady Cothen, FRA	Cothen 03-2003.pdf
8	Bob Dorer, Volpe	Dorer 03-2003.pdf

· Cindy Gross called to order the Full Working Group at 8 a.m. with a safety briefing.

· Ted Bundy made an announcement that a sign-in sheet will be passed around the meeting room listing each person's name and e-mail address. Please make any changes to your e-mail address. Mr. Bundy asked the Full Working Group to review the minutes of the October 2002 meeting. There were no changes to the minutes and the group voted to accept the minutes as published.

· Dr. Ted Giras, Dr. Ronald D. Williams, Dr. Lori M. Kaufman, Mr. Marc E. Monfalcone and Dr. Donald E. Brown, UVA gave an ASCAP detailed one-day briefing and presentation on what ASCAP does, and how it does it.

The group broke for lunch at 12 Noon. The meeting reconvened at 1:15 p.m.

· Continuation of the morning briefings from the University of Virginia.

· During the various UVA presentations, Cindy Gross took note of considerations various working group members wanted to be incorporated into the minutes. The considerations were all based on the UVA presentations. Roughly, these are as presented in the following table:

Miscellaneous Considerations

- The term "Distraction" sounds negative,
- Change "distraction" to "workload",
- Mine CAD - dispatcher performance/tasks,
- Quality and amount of training are very different on various railroads, and this should be taken into account,
- As employees become dependent on the advanced technology system, ensure they maintain "manual mode" of knowledge related to rule book (old way to operate without technology)
- Clearer understanding regarding rule compliance and emergency brake application; some emergency applications are the result of compliance with rules. UVA will put together a white paper on emergency brake application.

- Workloads should include:
  -- Motivation
  -- Density
  -- Performance objectives

- Signal failure - appliance device failure from FRA based on filings of the F6180.14 (Signal Failure Report)

- Improper maintenance(?) or repair needs to be considered in the model. "Unintended compromise of the system" (false clears, other errors etc.)
- Don't assume dispatchers initiate movements without errors.
- Need to consider human failure mechanisms beyond those represented. Attributes lead to those paths.

- Need to know how to return to operating without technology or in "conventional mode" of operating rule? Reliance on technology leads to loss of situational awareness?

- Are on track movements captured adequately? This takes much more of a dispatcher's time than normal train operations do, and adds to stress and workload. Add to model.
- Add when trains move from one system of operation to another (train moving from - to, voice control [dark] to CTC or ABS, etc.)

- Maintenance of way movements should be modeled into the UVA ASCAP string charts.
- The human factors model needs to be refined to ensure a better validation and verification method.

· Tim DePaepe indicated that the UP have not been represented at the last several meetings. He said the group is trying to validate a product to make sure the ASCAP model works, but UP didn't seem to be giving UVA the proper data.

· Ted Giras interjected, saying that UP had been giving UVA the data they need, and that the ASCAP modeling shouldn't be considered just to the NAJPTC project.

· Alan Polivka commented that UP has been supportive and responsive to the PTC project. He encouraged UVA/SDI to contact UP directly for their data needs, to follow up on those requests., and if problems are encountered to notify the PTC Program Office for additional help.

Meeting adjourned at 4:15 p.m.

March 5: Full Working Group Meeting convened at 8 a.m.

· Alan Polivka, AAR gave a progress briefing on the North American Joint Project (IDOT).

Jim Stem, UTU, asked Alan Polivka if he just stated that UTU has been involved in the North American Joint Project. Mr. Stem indicated that UTU has been trying to participate in this project and on one occasion was asked to leave the building in which the meeting was being held. Mr. Polivka responded that labor has been involved in a number of ways (safety document reviews, peer reviews of ASCAP, RSAC meetings, etc.). Tim DePaepe stated that since Mr. Polivka has been the manager of this project, labor has been more involved and plans to work with the AAR. Bob Harvey also commented that labor has been involved.

John Vogler, asked if the new high speed defect detectors would actually be able to detect inboard bearings used on passenger equipment. Bill Moore-Ede said that there would be onboard detection capabilities for the inboard bearing equipment.

Rick Inclima stated that the joint track and time authority to occupy the track is jointly granted to trains and on-track equipment. Mr. Inclima wanted to know how the PTC system would protect the roadway worker. Mr. Polivka answered that the PTC will protect the work limits. Bill Moore-Ede stated that anything that you can currently do today, you can do in PTC.

Mr. Inclima stated that within joint authority limits with trains and equipment, PTC will not provide enforcement. He said the PTC system is supposed to make it better today and he is not hearing that. Mr. Polivka indicated that there are a number of areas where there will be improved safety, including protection of the roadway workers. Rick Inclima stated that the issuance of joint track and time between trains and on-track equipment negates the core PTC feature meant to protect roadway workers and their equipment operating within the limits of their authority, and he didn't believe you can have joint track and time issued jointly to trains and equipment in a PTC system.

Mr. Polivka noted that the scope of the current project was established some time ago and is now beyond the point where significant changes can be made. Improvements suggested by the audience are good candidates for a future upgrade project.

Tim DePaepe said it was a financial decision that it was not provided today. Mr. DePaepe questioned whether the UP rule book prohibits joint occupancy. Tim said he has heard that they let it go on if it is prohibited. After the break, Dick Stotts clarified that the General Code of Operating Rules (GCOR) allows joint occupancy, but only after all parties to share the joint authority have been notified. Rick Inclima stated that with PTC there is an overlay which negates the joint track and time, and he didn’t believe you can have joint track and time with a train and equipment.

Denise Lyle asked, "Why is a third-party assessment necessary before the PSP has been submitted?" Grady answered by saying that one of the problems with the proposed rule is the sequencing. It would be unwise to wait until a full scale PSP was submitted, because too much work would have already been performed. FRA will need reassurance before then, that all of the "I's" have been dotted, etc. He said that doesn't mean that all projects would need a third party evaluation prior to submission of a PSP, but that it does apply for the IDOT project. He said we've found in the past, assumptions that certain projects would be a simple technology transfer from other countries, create unforeseen problems that have to be dealt with, using the ACSES system as an example.

Denise Lyle said that she thought the IDOT project, with all of the scrutiny and parties involved, would be the one that would not require a third party assessment. Grady said that the fact the IDOT project has a lot of participation, is precisely why FRA needs this data earlier than what is contemplated in the proposed rule.

· Craig Shier, Lockheed Martin, briefed the group on the North American Joint Project from the perspective of the System Developer/Integrator.

Rick Inclima asked if the ASCAP model will include Roadway Worker protection and to look at the four season variations. Mr. Shier said yes.

Mr. Shier stated that the earlier peer review consisted primarily of the labor group and the next level will be an industry review, with railroad involvement and reconnecting with labor.

· Howard Moody briefed the group on the various AAR Projects that interact with and support the PTC effort.

· Dr. Tom Raslear, FRA, briefed the group on the FRA sponsored Human Factors Team. Right now, the team is focusing on human reliability issues on the CSX CBTM and NAJPTC (IDOT) projects. He said the team is nearly ready to issue a draft report, and FRA should be able to share it with the PTC Working Group in the next couple of months. They have another project under development, which will be to develop a software program on human reliability issues, that PTC developers could use to step through an evaluation of the human factors issues that will arise in development and implementation of a new system.

  Dr. Raslear said FRA would also use this software model to perform analysis of these issues. A second software tool is a set of automation guidelines for technologies, indicating the types of principles one needs to look at for human-machine interfaces amongst other things. He said he is sponsoring a workshop on "close calls" in Baltimore April 23 and 24, 2003. He said close calls typically are not recorded, and the conference is designed to discuss how the industry could record close calls while shielding them from litigation. The point of contact for the conference is Jordan Multer. Rick Inclima asked if the group would be looking at close calls regarding only operations and operating rules, or would safety rules also be included. Tom said the intent was to just have an open discussion. Jordan said they have a website established for the conference, and the address is ***www.closecallsworkshop.com*****.**

· Bob Harvey said he wanted to bring up the joint "Collision Analysis" group, and asked if there was any way the information which that group is analyzing, could be folded into the overall human factors' piece. Tom Raslear said that he hadn't had any direct interface with this group, but that there may be value in getting that information and including it in the work the human factors' team is performing. John Wreathall, who is part of the human factors group, also said it would be valuable to get information from a variety of sources and determine if it would be useful. Grady Cothen pointed out that Rich McCord is coordinating efforts on accident data for FRA, and that anyone who had questions or wanted to provide feedback should contact FRA.

· John Vogler, NJT, briefed the group on the NJT ASES Project. While his presentation is available at the Volpe website, it's important to note that he agreed with what Grady had said about making assumptions that integration of a system can be straightforward. The NJT system combines ATC and SES (Speed Enforcement System, which is used in Europe), and there were problems. He said the integration of the two systems had never been done before.

The group broke for lunch at 11:20 a.m. The meeting reconvened at 1 p.m.

· Larry Light, Amtrak, and Jim Hoelscher, Alstom Signaling Inc., briefed the group on the ATK ACSES Project.

· Andy Schiestl, BNSF, briefed the group on the BNSF Quantum Train Sentinel System. Although his presentation is available on the Volpe website, it's important to note two things. One, Andy said he had been scheduled to speak on the Quantum system at two previous PTC meetings, and had to decline because of on-going legal negotiations between BNSF and Quantum. Two, he said that the BNSF Quantum is a pure overlay system. This system will overlay for all previous operating methods: Track Warrant (dark and ABS) and TCS. There is no intention to use it as a standalone system. ***Note: Andy's presentation included a 27" video, which is not included in these minutes, and cannot be made available on the Volpe website.***

Rick Inclima asked several questions regarding protection of roadway workers operating within the limits of their authorities. Andy responded the system achieves this PTC core feature, and also advises workers who are within ½ mile of other on-track equipment.

Tim DePaepe said he thought the IDOT project was supposed to set standards, and how was BNSF going to handle the interoperability issue. Andy said BNSF and CSXT are working to address interoperability of the two systems.

Grady asked about the signal interrogation feature and Andy said the interrogation was continual, and would advise if there were an aspect change. If the communication failed, the train would be stopped until the issue was resolved.

Bob Dorer asked if the system had all of the track data, and Andy responded that they were dealing with this by zone; for example from Chicago to LA.

Larry Light asked how signal information was relayed to the office, and Andy said the office wasn't given the information unless there was a communication failure between the device and the locomotive.

· Larry Light, Amtrak briefed the group on the ATK ITCS Project. There was no PowerPoint presentation. His presentation consisted of the following points:
- They are currently in service for 45 miles, from signal 150 to signal 195
- ITCS is overlaid on CTC with four controlled sidings. The main track is class 6, good for 110 mph. Three of the sidings are good for 30 mph, the other for 45 mph.
- There were two major problems preventing 110 mph operations; data radio coverage creating nuisance false restricted failures, and the contract was being finalized for 3rd party V&V audit.
- When the data radio coverage is improved, they expect to extend the in-service portion west from signal 195 to signal 216, for a total of 66 miles.
- Temporary speed problem: From Amtrak's perspective, with their experience with three cutting-edge train control systems, each very different from the others, the problem arises when a temporary speed file does not get downloaded to the train in a timely manner. On a real railroad, this can happen with some frequency. The question is: What do you do?
- In ITCS, they elected to display the fact that the file is missing and the engineer needs to look at his paper form. They require acknowledgment, and also retain the paper authority and the temporary speed signs. Then, they allow the display to resume, and the display of that information is still well known.
- The reason the did this was to attempt to continue to preserve all of the protection other than the temporary speed file, including permanent speeds, signal speeds, etc. Remember, the safety-critical display of temporary speed files includes CRC check sums, etc., which actually increase the possibility of this happening.
- The temporary speed file dilemma: When the file isn't downloaded in a timely manner, you have to decide whether to take a default of restricted speed over a long territory or a stop, either of which may result in cutting the system out and losing all protection for the remainder of the trip. The other option is to preserve as much of the system protection as you can, after adequately warning the engineer, and ensuring he has adequate backup.
- When the V&V is completed, they should be at 110 mph for all 66 miles.

· Cindy Gross, FRA, briefed the group on the January 27-29, 2003, Risk 2 Team meeting. Accidents for the period of 1988-1997 were previously reviewed. The team reviewed the 1998-2001 data set of 267 from a total population of 6,119 accidents. They used the same four design concepts used for classification of 1988 -1997.

· Ted Bundy asked the group to consider the following regarding use of a training model for both the training that will be needed, and the human factors modeling:
- Various people working on training and human factors are getting to the fringes of a classic task analysis model, but everyone seems to be avoiding actually entering the model. In other words, a lot of the work is being done, but it isn't being formalized.
- Although task analysis can be onerous, it needn't be. If the job descriptions for the various players (engineers, dispatchers, maintenance employees) are adequate, then basic assumptions can be made about the current knowledge and skill levels.

- Once those assumptions are validated, the task analysis itself would be reduced by about 90 percent.
- The task analysis itself requires at least two levels of validation: the subject matter experts (SME: design engineers, railroad technology liaisons, etc.), and the peer review. The SME must interface with the peer review group, and that group will advise whether steps are missing, or whether there are steps that can be eliminated.
- Two good things fall out of following a classic task analysis model: Formal classroom/lab training, and on-the-job training.
- A railroad training design/developer expert should be included to ensure the model is followed. If this is all done correctly, there will be a savings in human resources as well as money.

Meeting adjourned at 4:05 p.m.

March 6: Full Working Group Meeting convened at 8 a.m.

· Grady Cothen briefed the group on the Processor-Based Rule. His briefing notes are referenced in the table at the beginning of these minutes. Grady stopped in the middle of his briefing to let Bob Dorer brief on his topic.

· Bob Dorer briefed the group on the current Volpe work. His briefing notes are referenced in the table at the beginning of these minutes. Howard Moody wants a face to face debriefing once the review has been completed. Mr. Dorer indicated that it is fine as long as FRA is comfortable with the review and it needs to be coordinated with Rich McCord of FRA. Grady suggested that we stay with the 1988-1997 accident set, because if we try to use the current data the task becomes much more difficult.

Howard Moody suggested that the current accident data at least be compared against the older data to validate signal layers against methods of operation, and if discrepancies are found to do a manual update. There was further discussion on this topic, and Mr. Moody said the point is that the data points can be unstable if the control methods (Auto [on-board signals, train stop, train control], CTC, ABS, dark) aren't correct. He also had a concern that alternate values in the CRAM database have the following classifications: speed, method of operation, etc, and this be coincidental (agree with) the data in the accident/incident database.

· Grady Cothen continued his briefing. The Office of Chief Counsel representative will update the group on the progress of the rule at the next PTC meeting. Howard Moody asked Mr. Cothen to give his view on the requirement that new installations be monitored and data recorded so that results can be shown on the relative success of the installation. Grady agreed this was important, but said the problem has always been that we're not very successful in logging the data that is needed to make assumptions based on this data. Grady asked if any member of the working group wanted to help with the adjustments he had referred to, they would be welcome. These members do not have to respond to this invitation now.

Mr. Cothen read the following passage from the new requirement imposed on FRA by Congress.

***"Positive train control**-The Committee agrees with the National Transportation Safety Board that the current pace of development and implementation of collision avoidance technologies is inadequate. No plan for industry-wide integration has been developed. Progress has been particularly slow along rail lines that primarily serve freight carriers, and even those lines with significant passenger traffic remain largely unprotected today-some 12 years after positive train control was first placed on the Safety Board's "Most Wanted" list.*

The Committee directs FRA to submit an updated economic analysis of the costs and benefits of PTC and related systems that takes into account advances in technology, and systems savings to carriers and shippers as well as other cost savings that might be realized by prioritized deployment of these systems, especially along lines that might mix freight and passenger trains. That analysis should be submitted as a letter report to both the House and Senate Committees on Appropriations by October 1, 2003."

Mr. Cothen made the point that the Congressional requirement brings the term "business benefits" back into the equation. FRA plans to get a contractor to study the costs and the business benefits, and to have informal consultations with the PTC members as part of that process. The ART team will help to describe architectures with current relevance; and FRA will integrate the resulting cost and benefit information. FRA will try to get agreement amongst the members, but if the peer review of the draft letter report did not result in agreement on its content, FRA would note the contrasting views in it's final report. FRA, however, has an obligation to provide the required Report to Congress, as close to the date prescribed by Congress as is feasible. (Reference Slide 18 of the Cothen PDF file.) Grady indicated that he has already gone to the FRA Budget Director to advise him that the report may be delayed by a couple of months.

Ted Bundy reiterated what Grady discussed earlier, concerning the seating at the table. The members need to let Ted know who their first alternate is. Name tents will be prepared and placed on the table. The meeting will be held in Chicago on July 8 and 9 (we will try for the downtown Chicago area). Conditions of the meeting are as follows:

- There will be a hollow square to accommodate voting members, first alternates, and a small group of FRA people. A "hot seat" will be reserved for anyone who needs to make a contribution for an issue. That person will leave the "hot seat" once their contribution has been considered and recorded.
- Organizations who have more than one alternate are to provide Ted Bundy with the name of the person they consider their first alternate.
- Everyone else is invited and encouraged to come, but will be required to sit at the tables around the perimeter of the room.
- Breakout rooms will be reserved for caucuses.
- Any group who, upon return from a caucus, has substantive text they believe must be captured in the minutes, is obligated to provide the recorder with a word processing file. This is the only way the text can be captured satisfactorily.

Meeting adjourned at 9:30 a.m.

List of Participants:

No.	L_Name	F_Name	Organization	E-MAIL
1	Allen	Leonard	FRA	leonard.allen@fra.dot.gov
2	Anagnostopoulos	George	Volpe	anagnostopoulos@volpe.dot.gov
3	Bahue	Bill	IBEW	bill_bahue@ibew.org
4	Bley	Dennis	The WreathWood Group	bley@ieee.org
5	Bowles	Ryan	UVA	rpbowles@virginia.edu
6	Brown	Donald E.	UVA	brown@virginia.edu
7	Bundy	Ted D.	FRA	theodore.bundy@fra.dot.gov
8	Buxton	Robin	IBEW	rsbuxton@comcast.net
9	Caine	Brian	Lockheed Martin	brian.caine@lmco.com
10	Cothen	Grady	FRA	grady.cothen@fra.dot.gov
11	Crain	Sean	FRA	sean.crain@fra.dot.gov
12	Denton	Steven	FRA	steven.denton@fra.dot.gov
13	DePaepe	Tim	BRS	tjd@brs.org
14	Disk	Dan	Maglev Inc.	drdisk@maglevinc.com
15	Dorer	Bob	Volpe	dorer@volpe.dot.gov
16	Egnot	James	SIEMENS Transportation Systems	james.egnot@siemens.com
17	Fiorenzo	Leslie	FRA	les.fiorenzo@fra.dot.gov
18	Gamst	Frederick C.	University of Massachusetts/U. Wyoming	fcgamst@aol.com
19	Ghaly	Nabil N.	APTA	nabilghaly@aol.com
20	Gillen	Harold	Union Switch & Signal	hcgillen@switch.com
21	Giras, Ph.D.	Ted	University of Virginia	tgiras@virginia.edu
22	Goodman	William E.	FRA	william.goodman@fra.dot.gov
23	Gross	Cindy	FRA	cindy.gross@fra.dot.gov
24	Hagen	Bill	GE	bill.hagen@trans.ge.com
25	Hall	Barbara	FRA	barbara.hall@fra.dot.gov
26	Harris	James	CSX Transportation	james_harris@csx.com
27	Harvey	Robert A.	BLE	harvey@ble.org
28	Hoelscher	James	Alstom Signaling Inc.	james.hoelscher@transport.alstom.com
29	Horstman	Doug	BLE	dhorstma@orednet.org
30	Humphrey	Terrence L.	FRA	terrylhumphrey@fra.dot.gov
31	Inclima	Rick	BMWE	ricki@bmwe.org
32	Jackson	Ken	Battelle	jacksonk@battelle.org
33	Jarrett	Lynn	CSX	lynn_jarrett@csx.com
34	Kane	Mark	Quantum Engineering	mkane@qei.biz
35	Kaufman	Lori	UVA	lori@virginia.edu
36	Kollmar	Robert A.	AMTRAK	bkollmar@amtrak.com
37	Kuhn	Lawrence	FRA	lawrence.kuhn@fra.dot.gov

No.	L_Name	F_Name	Organization	E-MAIL
38	La Force	John	SEPTA	jlaforce@septa.org
39	Lester	Yvette E.	APTA	ylester@apta.com
40	Light	Lawrence E.	AMTRAK	lightl@amtrak.com
41	Lindsey	Ron	Consultant w/CSX	comarch@attbi.com
42	Lyle	Denise	AAR-CSX	denise_lyle@csx.com
43	Marceau	Fran	UTU	frogs@digisys.net
44	McClure	Karen	FRA	karen.mcclure@fra.dot.gov
45	McCown	Robert	FRA	robert.mccown@fra.dot.gov
46	McFadden	Daniel J.	AMTRAK	mcfaddd@amtrak.com
47	McPherson	Dale	BLE	d.l.mcpherson@att.net
48	Milhon	Larry R.	AAR-BNSF	larry.milhon@bnsf.com
49	Minger	Wayne	Consultant to FRA	wminger@aol.com
50	Monfalcone	Marc	University of Virginia	mem3f@virginia.edu
51	Moody	Howard	AAR	hmoody@aar.org
52	Moore Ede	Bill	CANAC Inc.	bmoorede@canac.com
53	Multer	Jordon	Volpe	multer@volpe.dot.gov
54	Mundy	Chuck R.	ATDD-BLE	atddcrm@hotmail.com
55	Newman	George J.	BLE	geonewman@aol.com
56	Petit	William A.	RPI - Safetran Systems	bill.petit@ieee.org
57	Polivka	Alan	Transportation Technology Center, Inc.	alan_polivka@ttci.aar.com
58	Ralph	R. W.	AAR-NS	rwralph@nscorp.com
59	Raslear	Thomas	FRA-Office of Research & Development	thomas.raslear@fra.dot.gov
60	Reid	Ray	IBEW	erdbeere@juno.com
61	Reilly	Eileen	AKRR	reillye@akrr.com
62	Reynolds	John	FRA	johnreynolds@fra.dot.gov
63	Roskind	Frank	FRA	frank.roskind@fra.dot.gov
64	Schiestl	Andy	BNSF	andrew.schiestl@bnsf.com
65	Schmidt	Karen	UVA	kschmidt@virginia.edu
66	Scieszinski	Bob	FRA	robert.scieszinski@fra.dot.gov
67	Shier	Craig	Lockheed Martin	craig.shier@lmco.com
68	Stem	James A.	UTU	jamesastem@aol.com
69	Stotts	S. H. (Dick)	ENSCO, Inc.	shstotts@aol.com
70	Sullivan	Patrick	NTSB	sullipa@ntsb.gov
71	Sullivan	Tom	UTU Local 7-E	tes@kdsi.net
72	Szabo	Joe	UTU	jcszabo@aol.com
73	Tilley	C. Ed	BNSF	c.tilley@bnsf.com
74	Tse	Terry	FRA	terry.tse@fra.dot.gov
75	Vogler	John	APTA/NJ Transit	jvogler@njtransit.com
76	Walters	Cindy	FRA	cynthia.walters@fra.dot.gov
77	Williams	Ronald D.	UVA	rdw@virginia.edu
78	Wilson	Frank	Wabtec Railway	mfwilson@wabtec.com

No.	L_Name	F_Name	Organization	E-MAIL
			Electronics	
79	Wreathall	John	The WreathWood Group	john@wreathall.com
80	Zerzan	Joe	Southwest Signal Engineering Co.	J_Zerzan@swsignal.com